

1 **CLAIMS:**

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3 1. A method of semantically classifying an image, the method
4 comprising:

5 obtaining an image and sub-dividing such image into multiple hierarchical
6 layered blocks, the blocks within a layer being at least partially coextensive;

7 determining a posterior estimate of class membership of a group of
8 hierarchical layered blocks, the estimate being based upon class likelihoods of the
9 hierarchical layered blocks in the group, such likelihood being conditioned on data
10 extracted from hierarchical layered blocks in the group;

11 semantically classifying a portion of such image based upon the posterior
12 estimate of class membership conditioned on the data extracted from the group of
13 hierarchical layered blocks local to such portion.

14
15 2. A method as recited in claim 1, wherein the determining comprises:

16 determining an estimated class likelihood of each block in the group of
17 hierarchical layered blocks;

18 combining the estimated class likelihoods of hierarchical layered blocks in
19 the group into a posterior estimate of semantic class membership.
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1 3. A method as recited in claim 1 further comprising:
2 repeating the classifying for each of multiple portions that substantially
3 cover the entire image;
4 categorizing the entire image based upon the result of such repeating of the
5 classifying.

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7 4. A method as recited in claim 1, wherein each successively lower
8 layer of the multiple hierarchical layered blocks is comprised of one or more
9 blocks which are smaller than and at least partially coextensive with one or more
10 blocks in a layer immediately above.

11
12 5. A method as recited in claim 1, wherein the determining comprises
13 extracting low-level features from blocks.

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15 6. A method as recited in claim 5, wherein the low-level features
16 comprise color and textures.

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18 7. A method as recited in claim 6, wherein the extracting extracts color
19 low-level features by an Ohta decomposition.

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21 8. A method as recited in claim 6, wherein the extracting extracts
22 texture low-level features by a complex wavelet transform.

1 **9.** A method as recited in claim 1, wherein the class likelihoods are
2 estimated in one-dimensional space.

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4 **10.** A method as recited in claim 1, wherein a classification that results
5 from the semantically classifying step is binary.

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7 **11.** A method as recited in claim 1, wherein a classification that results
8 from the semantically classifying step is selected from a group consisting of these
9 binary sets:

10 sky or not-sky;
11 grass or not-grass;
12 natural or man-made;
13 inside or outside;
14 hair or not-hair;
15 face or not-face.

16
17 **12.** An image retrieval method comprising:
18 a semantic image classification method as recited in claim 1;
19 searching for images matching a given query in an image library containing
20 images having portions thereof classified using the semantic image classification
21 method.

1 **13.** A computer-readable medium having computer-executable
2 instructions that, when executed by a computer, performs the method as recited in
3 claim 1.

4
5 **14.** A semantic image classification system, comprising:
6 a block analyzer configured to extract low-level features of blocks of an
7 image and estimate class likelihoods for each block, a class being a discriminating
8 semantic classification and a block being a portion of the image;

9 a combiner configured to generate a posterior estimate of class membership
10 based on combining estimated class likelihoods of hierarchical sets of blocks, a
11 hierarchical set of blocks being a hierarchical organized and associated blocks that
12 are, at least, partially coextensive;

13 an image classifier configured to determine and classify one of multiple
14 discriminating semantic classifications to localized portions of the image based
15 upon the posterior estimate of class membership of blocks comprising such
16 portions.

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18 **15.** A system as recited in claim 14 further comprising a hierarchy
19 definer configured to subdivide the image into multiple hierarchical sets of blocks,
20 each successively lower layer of a hierarchical set of blocks comprising one or
21 more blocks which are smaller than and at least partially coextensive with one or
22 more blocks in a layer immediately above.

1 **16.** A system as recited in claim 14, wherein the low-level features
2 comprise color and textures.

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4 **17.** A system as recited in claim 16, wherein the block analyzer extracts
5 color low-level features by an Ohta decomposition.

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7 **18.** A system as recited in claim 16, wherein the block analyzer extracts
8 texture low-level features by a complex wavelet transform.

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10 **19.** A system as recited in claim 14, wherein the class likelihoods are
11 estimated in one-dimensional space.

12
13 **20.** A system as recited in claim 14, wherein the discriminating semantic
14 classifications are selected from a group consisting of these binary sets:

- 15 sky or not-sky;
16 grass or not-grass;
17 natural or man-made;
18 inside or outside;
19 hair or not-hair;
20 face or not-face.

1 **21.** An image retrieval system comprising:
2 a semantic image classification system as recited in claim 14;
3 a semantic image querier configured to search for images matching a given
4 query in an image library containing images having portions thereof classified
5 using the semantic image classification system.

6
7 **22.** A computer-readable medium having stored thereon a data structure,
8 comprising an image library containing images having portions thereof classified
9 using a semantic image classification system as recited in claim 14.

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11 **23.** A computer-readable medium having stored thereon a data structure,
12 comprising:

13 a first data field containing data representing an image;
14 a second data field derived from the first field by determining one of
15 multiple discriminating semantic classifications of portions of the image via
16 hierarchical and probabilistic analyses;
17 a third data field functioning to delimit the end of the data structure.

1 24. A computer-readable medium having computer-executable
2 instructions that, when executed by a computer, performs the method comprising:
3 obtaining an image and sub-dividing such image into multiple hierarchical
4 layered and at least partially coextensive blocks;
5 determining posterior estimate of class membership by combining
6 estimated likelihoods of hierarchical layered blocks;
7 classifying a portion of such image as one of the multiple discriminating
8 semantic classifications based upon the posterior estimate of class membership of
9 hierarchical layered blocks local to such portion.